Fisheries and Oceans Canada | Pêches et Océans Canada
Ecosystems and Oceans Science | Sciences des écosystèmes et des océans

**Canadian Science Advisory Secretariat (CSAS)**

**Proceedings Series 2016/057**

**Central and Arctic Region**

# Proceedings of the regional peer review of the assessment of Dolly Varden from the Rat River, Northwest Territories

**February 10–11, 2015**
**Winnipeg, Manitoba**

**Chairperson: Margaret Treble**
**Editor: Colin Gallagher**

Fisheries and Oceans Canada
501 University Crescent
Winnipeg, Manitoba, R3T 2N6

December 2016

Canada

**Foreword**

The purpose of these Proceedings is to document the activities and key discussions of the meeting. The Proceedings may include research recommendations, uncertainties, and the rationale for decisions made during the meeting. Proceedings may also document when data, analyses or interpretations were reviewed and rejected on scientific grounds, including the reason(s) for rejection. As such, interpretations and opinions presented in this report individually may be factually incorrect or misleading, but are included to record as faithfully as possible what was considered at the meeting. No statements are to be taken as reflecting the conclusions of the meeting unless they are clearly identified as such. Moreover, further review may result in a change of conclusions where additional information was identified as relevant to the topics being considered, but not available in the timeframe of the meeting. In the rare case when there are formal dissenting views, these are also archived as Annexes to the Proceedings.

**Published by:**

Fisheries and Oceans Canada
Canadian Science Advisory Secretariat
200 Kent Street
Ottawa ON K1A 0E6

http://www.dfo-mpo.gc.ca/csas-sccs/
csas-sccs@dfo-mpo.gc.ca

© Her Majesty the Queen in Right of Canada, 2016
ISSN 1701-1280

**Correct citation for this publication:**

DFO. 2016. Proceedings of the regional peer review of the assessment of Dolly Varden from the Rat River, Northwest Territories; February 10–11, 2015. DFO Can. Sci. Advis. Sec. Proceed. Ser. 2016/057.

## TABLE OF CONTENTS


SUMMARY ..... IV

SOMMAIRE ..... IV

INTRODUCTION ..... 1

PRESENTATIONS AND DETAILED DISCUSSION ..... 1

- PRESENTATION 1: BACKGROUND ..... 1
- PRESENTATION 2: MARK-RECAPTURE POPULATION ESTIMATES ..... 1
  - Discussion ..... 2
- PRESENTATION 3: MARK-RECAPTURE STUDIES ..... 2
  - Discussion ..... 2
- PRESENTATION 4: FISH AGEING ..... 2
- PRESENTATION 5: GENETIC MIXED-STOCK FISHERY ANALYSIS ..... 3
  - Discussion ..... 3
- PRESENTATION 6: HARVEST ..... 3
  - Discussion ..... 4
- PRESENTATION 7: POPULATION MODELLING ..... 4
  - Discussion ..... 5
- PRESENTATION 8: RAT RIVER HARVEST MONITORING PROGRAM ..... 5
  - Discussion ..... 5
- PRESENTATION 9: POPULATION DEMOGRAPHICS (SEINING) ..... 6
- PRESENTATION 10: HABITAT RESEARCH ..... 6
- PRESENTATION 11: HARVEST MONITORING AND POPULATION DEMOGRAPHICS OF DOLLY VARDEN FROM THE FIRTH RIVER SYSTEM ..... 6

GROUP DISCUSSION ..... 7

- RESEARCH TO SUPPORT POPULATION ASSESSMENT ..... 7
- DEVELOPMENT OF SCIENCE ADVISORY REPORT (SAR) ..... 7
- NEXT STEPS ..... 7

REFERENCES ..... 7

APPENDIX 1: TERMS OF REFERENCE ..... 8

APPENDIX 2: LIST OF PARTICIPANTS ..... 10

APPENDIX 3: MEETING AGENDA ..... 11

## SUMMARY

A Regional Advisory Process was held at the Freshwater Institute in Winnipeg to assess anadromous Dolly Varden (*Salvelinus malma*) from the Rat River, Northwest Territories. The meeting was held on February 10 and 11, 2015 and included participants from Fisheries and Oceans Canada, the Fisheries Joint Management Committee, Gwich'in Renewable Resources Board, University of Manitoba, British Columbia Ministry of Environment, Parks Canada and harvesters from Aklavik and Fort McPherson. During the meeting, presentations were made on various topics relevant to the assessment including background information, multiple mark-recapture population estimates, biological information collected during mark-recapture, genetic mixed-stock fishery analysis, reported harvest, population modeling, and biological and catch-effort data collected from a harvest monitoring program. The meeting objectives were met and advice was provided to co-management partners, most importantly that the population was stable and the current level of harvest was sustainable. Publications from the meeting included a Science Advisory Report and Research Documents.


## Compte rendu de l'examen régional par les pairs de l'évaluation du Dolly Varden de la rivière Rat, dans les Territoires du Nord-Ouest


## SOMMAIRE

Un processus de consultation régional s'est déroulé à l'Institut des eaux douces, à Winnipeg, afin d'évaluer le Dolly Varden (*Salvelinus malma*) de la rivière Rat, dans les Territoires du Nord-Ouest. La réunion s'est tenue les 10 et 11 février 2015, avec la participation de représentants de Pêches et Océans Canada, du Comité mixte de gestion des pêches, du Conseil des ressources renouvelables Gwich'in, de l'Université du Manitoba, du ministère de l'Environnement de la Colombie-Britannique et de Parcs Canada, ainsi que de pêcheurs venus d'Aklavik et de Fort McPherson. Durant la réunion, des exposés ont été présentés et abordaient divers sujets pertinents à l'évaluation, notamment les renseignements généraux, les estimations de populations au moyen d'une méthode de marquage et de recapture, les renseignements biologiques recueillis lors du marquage et de la recapture, l'analyse génétique de stocks mélangés, la pêche déclarée, le modèle de population, et les données biologiques et sur l'effort de pêche recueillies dans le cadre d'un programme de surveillance des pêches. Les objectifs de la réunion ont été atteints et les partenaires de cogestion ont reçu des conseils leur indiquant avant tout que la population est stable et que le niveau actuel de pêche est durable. Les publications issues de la réunion comprennent un avis scientifique et des documents de recherche.

## INTRODUCTION

The purpose of the peer-review was to assess the status of anadromous Dolly Varden from the Rat River, Northwest Territories. Data from multiple sources (e.g., mark-recapture, genetics, and harvest monitoring) were reviewed in order to evaluate trends in population abundance, demographic properties, catch-effort, contribution to fisheries, and harvest rate. The meeting began with a review of the meeting terms of reference (Appendix 1), introductions of participants (Appendix 2) and review of the agenda (Appendix 3).

## PRESENTATIONS AND DETAILED DISCUSSION

### PRESENTATION 1: BACKGROUND

Presenter: Colin Gallagher and Kimberly Howland

The geography of the Rat River was described followed by an overview of the subsistence fishery, including timing, location, and gear type. The decline in population status and basic management milestones were described. Information was provided on how skip-migration in Dolly Varden from the Rat River was assessed (strontium concentration among otolith annuli using laser ablation) and how reproductive data recorded during the mark-recapture study were used to infer the relationship between skip-migration and reproduction. The results suggested the majority of the sampled fish skipped migration at least once in their lifetime in order to spawn in freshwater. Among Dolly Varden who skipped migration, most skipped at age six, and returned to the sea the following summer. Dolly Varden who skipped migration spawned in consecutive years less frequently compared to Dolly Varden that did not, which appeared to have consequences on vital parameters such as mortality. The results highlighted the diversity in life history for anadromous Dolly Varden from the Rat River and have implications in how the results from harvest-based monitoring programs are interpreted.

### PRESENTATION 2: MARK-RECAPTURE POPULATION ESTIMATES

Presenter: Colin Gallagher

The results of a mark-recapture study conducted between 2009 and 2014 were presented. The methods were described including capture method (seining at the spawning/overwintering area), locations where fish were captured, application of tags (t-bar at the base of the dorsal fin), and the collection of biological information (length, sex/reproductive condition). The recapture method was either from tag returns from the Rat River Harvest Monitoring Program or from seining conducted at the spawning/overwintering area at the end of September the following year. The Petersen model was utilized to estimate abundance. Assumptions of the Petersen model were reviewed and the methods used to adjust the data when assumptions were not fully met were described. Population estimates were generated for 2009, 2010, and 2013 for both methods of recapture. Abundance based on recaptures in the harvest monitoring program increased from 6,625 (95% CI = 4,199–12,769) to 14,891 (95% CI = 9,091–32,052) from 2009 to 2013, while abundance using recaptures in the seining increased from 5,792 (95% CI = 4,494–9,612) to 11,919 (95% CI = 7,773–23,638) from 2009 to 2013. The data were compared to estimates made periodically between1995 and 2004 and derived from recaptures in the monitoring program. The results are greater than the lowest observed abundance (approximately 2,900) estimated in 2004.

### Discussion

The chair asked participants how best to describe the trend in abundance given the uncertainties associated with the methods used to conduct the mark-recapture studies. Someone suggested abundance appeared stable and possibly increasing over the entire time series. A participant stated estimates in recent years were similar to those in the 1990s and higher compared to 2004. There was discussion about how Dolly Varden which skipped migration could affect the ratio of tagged and untagged fish available for recapture in the harvest monitoring program, possibly resulting in overestimating abundance. While abundance estimates tended to be higher based on tag returns from the harvest monitoring program compared to seining at the spawning/overwintering area, the temporal patterns in abundance were very similar between both methods. The uncertainty regarding interactions among density-dependence, environmental conditions, and the prevalence of skip-spawning for the Rat River stock was re-iterated.

## PRESENTATION 3: MARK-RECAPTURE STUDIES

Presenter: Neil Arnason

Methods available to examine mark-recapture data were discussed using data from Big Fish River Dolly Varden which were analyzed with the program MARK. An overview of closed- (Petersen and k-sample) and open- (Cormack-Jolly-Seber, Pradel, and Popan) population models along with assumptions and advantages were presented. Preliminary results from the Big Fish River suggested a slow growing yet stable population (conclusions consistent with DFO 2012). Additional refinements to the approach in the mark-recapture study were suggested (e.g., tag loss rate), however the approach taken in the Big Fish River appears to provide results that have a high degree of confidence, which bodes well for the studies conducted in other systems such as the Rat and Babbage rivers.

### Discussion

It was clarified that what is estimated in the mark-recapture models is the size of the catchable (using the seine net) population. Further work was necessary to compare the annual Petersen estimates to the results from the open model to see if they were similar and evaluate assumption violations (although preliminary examination suggest similar results). It was stated that it could be possible to combine both recapture methods used in the Rat into a single event using a Barker model in order to increase the sample size of recaptured fish, assuming both methods share similar parameters such as survivorship.

## PRESENTATION 4: FISH AGEING

Presenter: Colin Gallagher

An overview was provided of the current (since 2007, combination of whole and thin-section) and past (1990s–2012, whole) methodology utilized by two different readers (six years of overlap between readers) to estimate the age of Dolly Varden using otoliths. An age comparison study examined bias and precision within-readers, between-readers (whole otoliths), between-methods (whole vs sectioned), and between the final ages from both readers (regardless of method). Results indicated important discrepancies between both readers and preparation methods. The current age reader/methodology tended to produce older ages compared to the previous reader which suggested an underestimation of older ages, growth and mortality in the past. There was higher confidence in the data from the current reader/method based on repeatability measures and because the growth data match more closely the growth inferred

from mark-recapture studies. It was stated that an age validation study would be useful in order to determine if the current method provides accurate ages.

## PRESENTATION 5: GENETIC MIXED-STOCK FISHERY ANALYSIS

Presenter: Rob Bajno

Methods and results of a genetic mixed-stock fishery analysis using samples of Dolly Varden collected along the Canadian Beaufort Sea coast between 2011 and 2014, and from the Mackenzie Delta (Big Eddy in Husky Channel)/Rat River (mouth and Destruction City) between 2012 and 2014, were described. Microsatellite analysis (15 loci) was used to develop a genetic baseline of known stocks (n= 8), including samples from stocks in Alaska (note, the multiple Alaskan stocks were combined into three reporting groups). Statistical analyses were conducted to estimate the population of origin for individual samples and stock mixture analysis was done using both conditional maximum likelihood and Bayesian methods. Estimated stock contributions with 95% confidence intervals were presented for individual harvesting locations for each year. It was noted that it was not possible to genetically differentiate the Firth River, Joe Creek, and Kongakut River systems from each other with the information currently available. Along the coast, Dolly Varden from the Rat were predominantly captured at Shingle Point where the stock contributed between 5% (95% CI = 3–8) and 29% (95% CI = 20–39) of the harvest among sampling years. There were very low (e.g., ~1%, Ptarmigan Bay in 2011) or no captures of the Rat River stock at harvesting locations west of Shingle Point. At the sampling locations in the Mackenzie Delta/Rat River, the Rat River stock comprised 100% of the Dolly Varden sampled with the exception of the mouth of the Rat River in 2013 where 2% (95% CI = 0–5) (n = 1 fish) was assigned to the Big Fish River and 2% (95% CI = 0–5) (n= 1 fish) to the Vittrekwa River. It was emphasized that due to variability in fishing and sampling effort, and the timing and location of fishing activity these data may not provide an accurate representation of the coastal run.

### Discussion

One participant stated that the genetic baselines are strong which suggests that the results should be considered very accurate. It was emphasized that the compositions noted above represent inferences based upon genetic assignment tests; these may not indicate absolute contributions of a particular stock to a fishery. An observation was made that it would be interesting to know the reproductive status of the two strays observed at the mouth of the Rat River in 2013 to determine if they were going to the Rat River to spawn. A question was asked about confidence in the results, indicating the presence of two strays, and if these detections could be an error in analysis or genotyping. The presenter reiterated that frequencies of alleles shared among stocks were examined and no single allele discriminated among stocks, therefore, all results are based on probability. Otolith elemental composition has been shown to be a useful tool to discriminate among Dolly Varden stocks (Loewen et al. 2015) and might be used to determine if both strays were really from the Big Fish or Vittrekwa rivers.

## PRESENTATION 6: HARVEST

Presenter: Ellen Lea

The presentation provided an overview of how harvest information for Dolly Varden was collected and reported to various co-management bodies. Background information was presented on inland (i.e., non-coastal) harvesting locations (Mackenzie Delta, Rat River, Firth River, and Big Fish River [mouth and 'Fish Hole']). Detail was provided on specific locations where harvest and biological data were collected on an annual basis. Tables were presented

summarizing the community-based harvest level for the Rat River stock. The number of Dolly Varden allocated and harvested by the Rat River Harvest Monitoring Program and the communities of Fort McPherson (Gwich'in) and Aklavik (Gwich'in and Inuvialuit) between 2009 and 2014 were also presented. A table was provided summarizing the contribution of the Rat River stock to the coastal fishery at Shingle Point (between 2011 and 2014). The estimated total harvest of Dolly Varden from the Rat River ranged between 261 and 389.The harvest reporting programs were considered successful and the reported harvest data relatively accurate given the high degree of support by co-management partners and harvesters.

### Discussion

It was stated by a participant from Aklavik that the harvest is underreported in the community because of the way the monitor stationed in the community periodically collects information and that there would be better results if there was a monitor placed at the mouth of Husky Channel. Another participant reiterated that this is a voluntary program and that every year the Renewable Resource Councils / Hunters and Trappers Committee/ Gwich'in Renewable Resources Board / Fisheries and Oceans work hard to remind harvesters about the benefits of participating/reporting catches, however not everyone does. It is assumed that a large majority of the harvest was reported. It was stated that it was impossible to determine the number of people who did not report harvest; however it is possible to gain information from certain individuals who do not report to the monitoring program through casual conversations or from social media. Although it was suggested to increase the number of monitors/monitoring sites, it was emphasized that financial resources are limited and that it would be best to adapt/improve current programs based on suggestions from the communities. A participant from Aklavik stated that four to six nets are set in Aklavik when the char are running and that when the west wind picks up and there are whitecaps the char seem to surface and harvesters catch "a whole bunch". However, once the wind dies down so do the catches.

## PRESENTATION 7: POPULATION MODELLING

Presenter: Xinhua Zhu

Participants were given an overview of three population models (depletion-based stock reduction analysis (DB-SRA), surplus production (SPM), and statistical-catch-at-age (SCA)) used to evaluate maximum sustainable yield (MSY) and stock status of Dolly Varden from the Rat River. Total reported harvest (1972–2014) and the catch-effort (1996–2014) and biological data (1971–2014), mainly collected from the Rat River Harvest Monitoring Program (1995–2014) were used in the models. Data requirements and assumptions for each model, the interrelationships among certain stock production variables, and software utilized to run the models were also described. The models yielded estimates of the number of fish in the population and MSY, and the fishing mortality ($F_{MSY}$) and equilibrium exploitation rate ($U_{MSY}$) at MSY. The DB-SRA model produced a higher estimate of MSY compared to SPM and SCA models which were similar to each other. A single MSY value ± 1 SD (891 ± 81) was estimated by using the inverse-variance weighted mean of all three models. Some of the uncertainties associated with the data used in the models included accuracy of the harvest survey in estimating the number of char that were harvested, precision/ accuracy of fish ages, low sample size in some years, and representativeness of the biological sample. The models suggested that there were instances of overharvest in the past, however the current level of harvest appears to be below MSY and the stock status is healthy ($B_t/B_{MSY}$ and $SSB_t/SSB_{MSY}$ were >1, and $F/F_{MSY}$ was <1) (DB-SRA and SPM).

## Discussion

One participant suggested removing the small number of age-1 samples from the length- and weight-at-age analyses used for model parameterization as these exhibited a high degree of influence on the parameters of the curves. A participant noted that the DB-SRA model may not be accurate as it is likely sensitive to high variation in harvest during the initial phase of the time-series, which was observed for the Rat River stock. A question was asked whether the change in age-readers resulted in the dramatic increase fishing mortality observed in the last two years of the SCA model. This was a possibility given that $F/F_{MSY}$ was <1 if the last two years were removed from SCA model. A suggestion was made to conduct a retrospective analysis of the modelling. One participant asked why the mark-recapture data were not used in age-structured analysis to help validate the model. During the discussion, it was stated that the SPM appeared to best describe what was observed in the population (i.e., stock was depleted in the past and is now rebuilding due to reduced fishing effort), however someone stated that age-based models (SCA) are very powerful and that the similarities in MSY between SPM and SCA models provided confidence in their results. It was suggested to take the inverse-variance weighted mean of the SPM and SCA models to estimate MSY for the population given the reduced confidence in the DB-SRA. There was support to use the models to provide management advice. Finally, it was emphasized to maintain harvest under MSY.

## PRESENTATION 8: RAT RIVER HARVEST MONITORING PROGRAM

Presenter: Colin Gallagher

The results of the catch-effort and biological data collected in the Rat River Harvest Monitoring Program (1995–2014) were presented. An overview of the program was provided detailing the three monitoring locations (Big Eddy in Husky Channel of the Mackenzie River and in the Rat River at the mouth and a location known as Destruction City), the fishing gear that was used, and what data were collected. Annual catch-per-unit-effort were tabulated separately for each location and plotted to infer changes in relative abundance. Biological information (e.g., length and weight) were analyzed using parametric or non-parametric statistics and evaluated for trends over time. Age frequency and age-related metrics such as annual mortality and growth were estimated using data generated since 2009 with the current ageing protocol (Gallagher et al. 2016). Results between 2009 and 2014 were emphasized for the assessment. Median CPUE demonstrated a sinusoidal pattern with high values in the late 1990s and from 2011–2012, and low values from 2002–2006 and 2013–2014. The biological results demonstrated that char were mainly between 350 and 550 mm/560–1,900 g in size with a greater proportion among larger sizes (≥550 mm) observed in the sample starting in 2010. Ages ranged between three and 13 years. The proportion of older ages (≥8 years) increased between 2009 and 2014, resulting in a decrease in annual mortality from 0.67 to 0.45. Length-at-age appeared stable among years. The proportion of males spawning in the current-year increased starting in 2011. The results from the Rat River Harvest Monitoring Program suggested improvement in stock status at the current level of harvest.

## Discussion

A participant from Aklavik asked if the harvest monitors were using the same mesh type every year (e.g., nylon/cotton and colour) given that he's seen this affect catches along the coast. The reply was that the monitor at Big Eddy had been using the same gill nets since the program began and that it was assumed the other monitors were maintaining consistent gear type among years. During discussion about the run timing of Dolly Varden from the Rat River, it was clarified that monitors started the program when the run begins (approximately end of July at Big Eddy and approximately one week later for the other locations). A participant stated that the

run can start mid-July and that catches can fluctuate dramatically over the course of the run. One person stated that it seemed as if the run was becoming more protracted over time. It was mentioned that harvesters can catch char well into September after the monitoring program is completed.

## PRESENTATION 9: POPULATION DEMOGRAPHICS (SEINING)

Presenter: Colin Gallagher

The results of the biological data collected by seining for the mark-recapture studies at the spawning and overwintering area in Fish Creek (tributary to Rat River) periodically since 1995 and annually since 2009 were presented with an emphasis on 2009–2014 for the assessment. The length of female and male spawners was mainly distributed between 450–575 and 500–600 mm, respectively. Dolly Varden not spawning in the current year (immature or resting) was mainly distributed between 400–575 mm. Relative to earlier sampling years, the proportion of large-size fish (≥550 mm) was highest in most years after 2009 (7.3–37%). The proportion of male spawners was highest in most years starting in 2009 while the proportion of female spawners decreased (70–~33%) between 2009 and 2014. Concurrent with the decline in female spawners was the increase in the proportion of non-spawners from 19.4% in 2009 to ~60% in 2013/2014. Females spawned in consecutive-years more often than males. The consistent presence of a wide distribution of sizes and high proportion of fish in spawning condition in recent years suggested the population was currently stable.

## PRESENTATION 10: HABITAT RESEARCH

Presenter: Kris Maier

Background information was provided on a project to assess the habitat of juvenile Dolly Varden in Fish Creek (Rat River stock). The methods to collect occupancy information, habitat data, benthic invertebrate samples, and a dead-sample for biological information were described. The preliminary results from the first year of data collection (summer 2014) indicated juvenile char inhabited high-gradient tributaries in the headwater area of Fish Creek and in the upper reaches of Fish Creek proper.

## PRESENTATION 11: HARVEST MONITORING AND POPULATION DEMOGRAPHICS OF DOLLY VARDEN FROM THE FIRTH RIVER SYSTEM

Presenter: Colin Gallagher

Information was presented to provide background to meeting participants regarding other stocks where assessment data was also collected. Preliminary length and age data on Dolly Varden from the Firth River system (mainly lower reaches) captured by angling and sampled by staff from Parks Canada during the summer between 2010 and 2014 was presented. The biological data from the seining conducted in the spawning and overwintering area in September 2014 in Firth River and Joe Creek were compared to data from earlier years. Preliminary results suggest stability in the length structure of fish harvested by angling. Preliminary results of the seining data indicate a high proportion of non-spawners in the Firth River (with no apparent change in demographic properties since the late 1980s) and a high proportion of spawners in Joe Creek. It was suggested that limitations in the geographical extent of sampling may have influenced the results.

## GROUP DISCUSSION

### RESEARCH TO SUPPORT POPULATION ASSESSMENT

An open discussion was held regarding the research needs for improving the methods used to collect information to assess Dolly Varden from the Rat (harvest monitoring and seining/ mark-recapture) and Babbage (seining/ mark-recapture) rivers. Discussion revolved around topics of mark-recapture, life history, and population modelling. A suggestion was made to evaluate alternative models using the program MARK. Additionally, these models may be more appropriate for the Rat River given that some fish skip migration whereby not all fish are equally vulnerable to the recapture in the harvest monitoring program. A participant with expertise on mark-recapture supported the current methodology used to deploy tags in order to maintain consistency among river systems and reduce heterogeneity in parameters allowing for parsimonious model selection. Additional work could be done to address tag loss. Someone suggested that in order to decrease the 95% confidence intervals around estimates it would be necessary to deploy more tags and obtain more recaptures. Research to determine the proportion of the catch and tag returns that are unreported would also be beneficial in order to more accurately determine the harvest rate. It was suggested to formally develop biological indicators/ reference points in a traffic-light approach similar to what is being done on the Big Fish River for decision-making. During discussions regarding modelling, retrospective analysis was suggested to address issues of uncertainty, make better use of the predictive power of models rather than use them for reconstructing the history of population dynamics, and to use the mark-recapture population abundance estimates to tune the models.

### DEVELOPMENT OF SCIENCE ADVISORY REPORT (SAR)

The Science Advisory Report was developed collaboratively by all participants during the meeting. The results of the analysis to estimate effective population size ($N_e$ = 608 [-95% CI= 212; note that +95% CI could not be calculated when combining means within methods due to some results of infinity]) for Dolly Varden from the Rat River were made in the presentation for Babbage River.

### NEXT STEPS

The research documents proposed as outputs of the peer-review were confirmed by the chair of the meeting. The chair thanked all participants for their input into the discussions and adjourned the peer review.

## REFERENCES


DFO. 2012. Assessment of Dolly Varden from the Big Fish River, NT 2009-2011. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2012/065.

Gallagher, C.P., Howland, K.L., and Wastle, R.J. 2016. A comparison of different structures and methods for estimating age of northern-form Dolly Varden *Salvelinus malma malma* from the Canadian Arctic. Pol. Bio. 39: 1257–1265.

Loewen, T.N., Reist, J.D., Yang, P., Koleszar, A., Babaluk, J.A., Mochnacz, N., and Halden, N.M. 2015. Discrimination of northern form Dolly Varden Char (*Salvelinus malma malma*) stocks of the North Slope, Yukon and Northwest Territories, Canada via otolith trace elements and $^{87}Sr/^{86}Sr$ isotopes. Fish. Res. 170: 116–124.

## APPENDIX 1: TERMS OF REFERENCE

**ASSESSMENT OF DOLLY VARDEN, *SALVELINUS MALMA MALMA*, FROM THE RAT RIVER, NORTHWEST TERRITORIES**

**Regional Peer Review – Central and Arctic Region**

**February 10-11, 2015**
**Winnipeg, Manitoba**

Chairperson: Margaret Treble

**Context**

Situated in the Gwich'in settlement Area (GSA), the Rat River is inhabited by anadromous Dolly Varden that are harvested by both Gwich'in and Inuvialuit beneficiaries. The harvest of Dolly Varden from the Rat River occurs during the summer at feeding areas along the coast (by the Inuvialuit) and also during the upstream migration in the Mackenzie Delta (by both the Gwich'in and Inuvialuit). Dolly Varden are co-managed under an Integrated Fisheries Management Plan (IFMP) whose signatories include Fisheries and Oceans Canada (DFO), Gwich'in Renewable Resources Board, Fisheries Joint Management Committee, and Parks Canada Agency. The Rat River Working Group, the co-management body that makes recommendations for voluntary harvest levels for Dolly Varden stocks in the GSA, has supported research activities that facilitate implementation of the IFMP, including studies to monitor harvest levels and assess the population status.

Dolly Varden from the Rat River were last assessed in 2008. Fisheries Management has requested an updated assessment and evaluation of population status for the Rat River stock.

**Objectives**

Fisheries Management requests Science advice on stock status, abundance estimates and sustainable harvest levels for the Rat River stock based on the following:

1) Comparison of current and past population estimates (based on mark recapture methods);
2) Estimates of effective population size (using genetic methods) and how it relates to the mark-recapture estimates of population size;
3) Comparison of current biological information (length, weight, age, sex, maturity, and growth) (2009-2014) with past data (1995-2008) collected through the Rat River Harvest Monitoring Program and the seining program at the spawning/ overwintering area;
4) Population dynamics modelling using total harvest, catch-effort, biological, and abiotic (water levels and debris) information; standardize catch per unit effort related to fishery-dependent monitoring of stock status; and generate biological reference points;
5) Evaluation of the contribution of Dolly Varden from the Rat River to the mixed-stock-fishery at Shingle Point, Herschel Island, and Ptarmigan Bay using genetic mixed stock fishery analysis (2011-2014);
6) Compilation of annual harvest information for Dolly Varden captured along the Beaufort Sea coast and in the Mackenzie Delta (2009-2014); and
7) Estimation of sustainable harvest levels and the associated risks for the stocks.

**Expected Publications**

- Science Advisory Report
- Proceedings
- Research Document(s)

**Participation**

- Fisheries and Oceans Canada (DFO) (Ecosystems and Oceans Science, and Ecosystems and Fisheries Management sectors)
- Fisheries Joint Management Committee
- Aklavik Hunters and Trappers Committee
- Academics
- Other invited experts

## APPENDIX 2: LIST OF PARTICIPANTS

Dennis Arey, Harvester (Aklavik), Inuvialuit fisheries expert

Neil Arnason, P[illegible]essor, University of Manitoba, science expert

Burton Ayles, Fisheries Joint Management Committee, science expert

Rob Bajno, chemist, DFO (Winnipeg), science expert

Heather Clark, technician, DFO (Winnipeg), meeting rapporteur

Brian Dempson, Research Scientist, DFO (Newfoundland), science expert

Margaret Docker, Professor, University of Manitoba

Colin Gallagher, biologist, DFO (Winnipeg), science expert

Danny C. Gordon, Harvester (Aklavik), Inuvialuit fisheries expert

Les Harris, biologist, DFO (Winnipeg), science expert

Kimberly Howland, Research Scientist, DFO (Winnipeg), science expert

Curtis Illasiak, Harvester (Aklavik), Gwich'in fisheries expert

Ellen Lea, biologist, DFO (Inuvik), science/fisheries expert

Tracey Loewen, graduate student, University of Manitoba, science expert

Kris Maier, biologist, GRRB (Inuvik), science/ fisheries expert

Neil Mochnacz, biologist, DFO (Winnipeg), science expert

Jim Reist, Research Scientist, DFO (Winnipeg), science expert

Peter Sinkins, Parks Canada (Inuvik) [teleconference]

Ross Tallman, Research Scientist, DFO (Winnipeg), science expert

Rick Wastle, technician, DFO (Winnipeg), fish ageing expert

Doug Watkinson, biologist, DFO (Winnipeg), science expert

Abe Wilson, Harvester (Fort McPherson), Gwich'in fisheries expert

Brett van Poorten, researcher, Conservation Science Section, British Columbia Ministry of Environment (Vancouver), modelling/ science expert [teleconference]

Xinhua Zhu, Research Scientist, DFO (Winnipeg), science expert

## APPENDIX 3: MEETING AGENDA

Assessment of Dolly Varden, *Salvelinus malma malma*, from the Rat River, Northwest Territories (February 10-11, 2015)

**Tuesday February 10**

| Time | Topic | Presenter |
|---|---|---|
| 9:00-9:30 | Preliminary results of Dolly Varden population studies in Firth River/ Joe Creek (provides context to North Slope assessment) | C. Gallagher |
| 9:30-9:35 | Review of Terms of Reference (Rat R.) | M. Treble |
| 9:35-9:50 | Dolly Varden from the Rat River: background | C. Gallagher |
| 9:50-10:30 | Rat River Harvest monitoring program | C. Gallagher |
| 10:30-10:45 | Break | |
| 10:45-11:15 | Rat River Harvest monitoring program | C. Gallagher |
| 11:15-12:00 | Mark-recapture population estimates | C. Gallagher |
| 12:00-13:15 | Lunch | |
| 13:15-13:45 | Fish ageing | C. Gallagher |
| 13:45-14:15 | Genetic stock composition of fishery in Mackenzie Delta | R. Bajno |
| 14:15-14:45 | Harvest survey | E. Lea |
| 14:45-15:00 | Break | |
| 15:00-16:30 | Population modelling of Dolly Varden from the Rat River | X. Zhu |

**Wednesday February 11**

| Time | Topic | Presenter |
|---|---|---|
| 9:00-9:45 | Population demographics (fall seining) | C. Gallagher |
| 9:45-10:30 | Habitat research | K. Maier |
| 10:30-10:45 | Break | |
| 10:45:12:00 | Discussion of research needs | M. Treble |
| 12:00-13:15 | Lunch | |
| 13:15-14:45 | Develop conclusions/ advice for the Science Advisory Report | M. Treble |
| 16:30 | Conclude meeting | M. Treble |